Name: _____
(Please print.)

Your Student ID Number: | | | | | | | | | | | | | | |

Form 204

PreACT® 8/9

Directions

This booklet contains tests in English, math, reading, and science. These tests measure knowledge and skills related to your course work and your readiness for high school study. **Calculators may be used on the math test only.**

The questions in each test are numbered, and the suggested answers for each question are lettered. On the answer document, the rows of ovals are numbered to match the questions, and the ovals in each row are lettered to correspond to the suggested answers.

For each question, first decide which answer is best. Next, locate on the answer document the row of ovals numbered the same as the question. Then, locate the oval in that row lettered the same as your answer. Finally, fill in the oval completely. Use a soft lead pencil and make your marks heavy and black. **Do not use ink or a mechanical pencil.**

Mark only one answer to each question. If you change your mind about an answer, erase your first mark thoroughly before marking your new answer. For each question, make certain that you mark in the row of ovals with the same number as the question.

Only responses marked on your answer document will be scored. Your score on each test will be based only on the number of operational questions you answer correctly during the time allowed for that test. You will **not** be penalized for guessing. **It is to your advantage to answer every question even if you must guess.**

You may work on each test **only** when the testing staff tells you to do so. If you finish a test before time is called for that test, you should use the time remaining to reconsider questions you are uncertain about in that test. You may **not** look back to a test on which time has already been called, and you may **not** go ahead to another test. To do so will disqualify you from the examination.

Lay your pencil down immediately when time is called at the end of each test. You may **not** for any reason fill in or alter ovals for a test after time is called for that test. To do so will disqualify you from the examination.

Do not fold or tear the pages of your test booklet.

DO NOT OPEN THIS BOOKLET UNTIL TOLD TO DO SO.

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* 0 2 6 8 9 6 2 5 0 *

1

ENGLISH TEST

30 Minutes—40 Questions

DIRECTIONS: In the three passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose "NO CHANGE." In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

PASSAGE I

The Midwest's Many Palaces

In 1887, the people of Sioux City, Iowa, chose an unusual way to celebrate a year of exceptional harvests: they built a palace dedicated to corn. Built with wood, [1] this elaborate structure in Sioux City, Iowa, [1] covered 18,500 square feet, was decorated with 20,000 bushels of corn, and featured arches, flying buttresses, a 100-foot tower, and detailed murals made of grain. Newspapers across the country ran articles on the palace. As a result, over 130,000 people traveled to see it, including then-president Grover Cleveland. Given that the palace was [2] so well received that other midwestern communities decided to create palaces of their own.

1. What change, if any, to the underlined text would make the sentence least redundant?

A. NO CHANGE
B. Built of wood in Iowa, the elaborate structure
C. This elaborate wood structure in Sioux City
D. This elaborate wood structure

2. **A.** NO CHANGE
B. Because the palace was
C. The palace was
D. The palace,

1

What followed was a trend that lasted into the 1930s. Palaces dedicated to coal, flax, hay, and bluegrass sprang up in Iowa[3] others celebrating corn, hay, coal, and broomcorn were built in Illinois. South Dakotans created palaces devoted to corn, alfalfa, and grain, in case[4] Nebraskans erected one for sugar beets. Each of these palaces was[5] the centerpiece of a local festival that was usually well attended.[6] Visitors could listen to speeches and concerts, admire exhibits of local goods, and watch parades and fireworks.

The palaces were more than just festive gathering places. They were also intended to impress visitors, especially those from the wealthier and more densely populated east.[7] Investors could be convinced to fund local business ventures, and families might be drawn to move to the region. With more people coming to, and investing in the region, communities could grow[8] and prosper even more.

3. **A.** NO CHANGE
B. Iowa however,
C. Iowa, while
D. Iowa,

4. Which choice makes the sentence most logical?
A. NO CHANGE
B. even though
C. unless
D. and

5. **A.** NO CHANGE
B. were being
C. have been
D. were

6. Given that all the choices are accurate, which one provides the most effective transition to the next sentence?
A. NO CHANGE
B. often funded largely by local businesses.
C. that required months of preparation.
D. offering a variety of attractions.

7. If the writer were to delete the underlined text (adjusting the punctuation as needed), the essay would primarily lose a:
A. detail that reveals whom the communities particularly wanted to attract and why.
B. hint about what tempted some people to visit the palaces.
C. clue about why some people liked decorating with grain.
D. suggestion regarding where palaces would be built next.

8. **A.** NO CHANGE
B. to, and investing in, the region, communities could grow,
C. to and investing in the region, communities could grow
D. to and investing in the region, communities could grow,

1

While the palaces brought communities
9
together and encouraged growth, were expensive
9
and, in most cases, not built to last. Many palaces

were attractive to pests that fed on them, but
10
others were left in place for a few years before

they were dismantled. Today, only one remains
11

standing: a corn palace in Mitchell, South Dakota.
12
Adorned with mosaics using thirteen different

colors of corn, this serves as a reminder of the
13
festival fever that once swept the region.

9. **A.** NO CHANGE
B. While the palaces brought communities together and encouraged growth, they
C. Bringing communities together and encouraging growth, the palaces, which
D. Bringing communities together and encouraging growth; the palaces

10. Given that all the choices are accurate, which one provides the most relevant information at this point in the essay?

A. NO CHANGE
B. quite large, with one even accommodating a trolley line down its center,
C. torn down soon after their festivals ended,
D. fire hazards,

11. Which of the following alternatives to the underlined text would NOT be acceptable?

A. At present,
B. Currently,
C. Lately,
D. Now,

12. **A.** NO CHANGE
B. standing; a corn
C. standing a corn,
D. standing a corn

13. **A.** NO CHANGE
B. the palace serves
C. that serves
D. some serve

PASSAGE II

The Best Bread in Town

If you've only eaten pre-sliced, plastic-wrapped supermarket bread before now, you have a treat in store for you. More easily than you might think you can pull a fragrant loaf of homemade bread from your oven and enjoy it [16].

Because white bread is easier to make, it is a good one to begin with. You'll need water, a package of baker's yeast, salt, sugar, oil, and about four cups of white flour. In an organized manner, place everything you need on a counter large enough for you to work comfortably.

Pour one and a half cups of lukewarm water, into a large bowl. Sprinkle the baker's yeast over the surface of the water; then add a tablespoon of sugar. In five minutes, the yeast will begin to bubble. As soon as it does, add: a pinch of salt and a tablespoon of oil. Next, add the flour, a half cup at a time. There are many ways to measure the correct amount of flour, but the simplest rule is best: add enough so the dough is not too sticky to handle, but no more.

14. Which choice best helps establish the point that supermarket bread is lacking something that homemade bread can provide?

A. NO CHANGE
B. the best selling,
C. commercially advertised,
D. bland, mass-produced,

15. **A.** NO CHANGE
B. easily than you might think,
C. easily than you might think;
D. easily, than you might think,

16. At this point, the writer is considering adding the following clause:

while it is still warm

Should the writer make this addition here?

A. Yes, because it appeals to the reader's senses and supports the point that homemade bread is a treat.
B. Yes, because it serves as an important transition to the next paragraph.
C. No, because it is redundant, as the writer has already indicated the loaf is fragrant.
D. No, because it is an irrelevant detail that bears no relationship to plastic-wrapped supermarket bread.

17. Given that all the choices are true, which one best supports the point that a novice baker should probably make white bread first?

A. NO CHANGE
B. more appealing than other kinds.
C. the most popular bread for sandwiches.
D. the kind sold most often.

18. **A.** NO CHANGE
B. cups of lukewarm water
C. cups' of lukewarm water
D. cups, of lukewarm water

19. **A.** NO CHANGE
B. does add:
C. does, add
D. does; add

1

Now that the dough is no longer sticky and holds together in a ball so it is ready to be kneaded. Press down with the heel of one hand, and then give the dough a quick half turn with the other, repeat this motion until the dough looks smooth and glossy. Then, put the dough in a large, greased bowl.

Next, find a warm, draft-free place to put the dough since draping a towel over the bowl. After about an hour, the dough will have risen to twice its original size.

Punch the dough to let out the air, shape it into a loaf, and set it into a greased bread pan to rise a second time. Preheat the oven to 350 degrees until it is hot.

When the bread has matched itself in size again, slide it into the oven and bake it for about forty minutes. When the crust is golden, take the loaf out of the oven, remove it from the pan, and tip it upside down on the counter. Tap the bottom of the loaf; if it sounds as if it's hollow, it's done.

20. **A.** NO CHANGE
B. ball, so
C. ball;
D. ball,

21. **A.** NO CHANGE
B. the dough is given a circular movement to cause a quick half turn
C. allow the dough to change its position by half
D. rotate the dough around in a half circle until it is turned halfway

22. **A.** NO CHANGE
B. other hand repeat
C. other hand, repeat
D. other. Repeat

23. **A.** NO CHANGE
B. dough draping
C. dough, and drape
D. dough, drape

24. **A.** NO CHANGE
B. it's
C. of its
D. its'

25. **A.** NO CHANGE
B. degrees; until it is hot.
C. degrees, until it heats up.
D. degrees.

26. **A.** NO CHANGE
B. doubled in
C. twice its
D. produced its

PASSAGE III

Horses Ask for Help

Since horses were domesticated, about 6,000 years ago, they have aided humans with work, provided them with transportation, and are serving [27] as affectionate companions. This bond between humans and horses has impressed [28] researchers Monamie Ringhofer and Shinya Yamamoto, at Kobe University in Japan, to study how connections between domesticated animals and humans are developed and sustained. In particular, they are interested in how animal-to-human communication facilitates [29] such bonds. They are also searching for the link between domestication and cognitive abilities in animals.

In 2016, during a two-part study of how horses communicate, [30] the researchers learned that when horses face certain challenges they can't resolve, they initiate particular types of communication with humans to indicate that they need help. For their study, the researchers, when hiding [31] carrots inside covered buckets while it [32] watched them.

27. **A.** NO CHANGE
B. having served
C. to serve
D. served

28. The writer wants to indicate that the researchers were enthusiastic about conducting their studies. Which choice best accomplishes that goal?

A. NO CHANGE
B. inspired
C. forced
D. caused

29. Which choice makes the sentence most precise?

A. NO CHANGE
B. forwards
C. pushes
D. eases

30. Given that all the choices are accurate, which one would provide the most effective transition from the preceding paragraph to the rest of the essay?

A. NO CHANGE
B. while reading various studies about animal cognition,
C. after having studied chimpanzees,
D. while working in Japan,

31. **A.** NO CHANGE
B. in which the researchers hid
C. the researchers, hiding
D. the researchers hid

32. **A.** NO CHANGE
B. the horses
C. those
D. they

Then, the researchers positioned the buckets so the
33

horses could see these but couldn't get to them. The
34

horses' caretakers—whom were not present when
35
the food was hidden—then approached and stood near the animals. All the horses in the study used signals to "tell" the humans that there was food nearby: they looked
36
at, stayed close to, and nudged their caretakers with their heads. The horses spent a measurably longer time engaging in these signaling behaviors when the buckets were full than when they were empty.

In the second part of the study, the researchers again
37
placed carrots in buckets for a second time while both the
37
horses and caretakers watched. Again, the horses signaled

their caretakers. This time, however, the horse's signals
38
lasted for a much shorter duration.

The movements suggested not only that the horses deliberately tried to communicate with humans when they needed assistance in obtaining food, also that they could
39
determine whether the humans knew that there was food in the buckets. Ringhofer suggests that this study provides compelling evidence of sophisticated cognitive and communicative skills that help horses to establish and maintain bonds with humans.

33. **A.** NO CHANGE
B. For example,
C. Suddenly,
D. Finally,

34. **A.** NO CHANGE
B. those
C. them
D. it

35. **A.** NO CHANGE
B. whom was
C. who were
D. who was

36. **A.** NO CHANGE
B. nearby, the horses
C. nearby and they
D. nearby, they

37. What change, if any, to the underlined text would make the sentence least redundant?

A. NO CHANGE
B. the researchers, in the presence of the horses and caretakers, placed carrots in buckets
C. the researchers conducting the study placed carrots in buckets
D. the researchers placed carrots in buckets

38. **A.** NO CHANGE
B. horses' signals'
C. horses' signals
D. horses signals'

39. **A.** NO CHANGE
B. additionally
C. as well as
D. but also

Question 40 asks about the preceding passage as a whole.

40. Suppose the writer's primary purpose had been to describe a scientific study that has influenced many other studies. Would this essay accomplish that purpose?

- **A.** Yes, because it discusses a number of real-world and scientific influences on Ringhofer and Yamamoto's study.
- **B.** Yes, because it explains why horse-to-human communication is so important.
- **C.** No, because it instead provides an overview of the process and results of one particular study by Ringhofer and Yamamoto.
- **D.** No, because it instead explains that Ringhofer and Yamamoto based their study on earlier studies.

END OF TEST 1

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

2

MATH TEST

40 Minutes—35 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

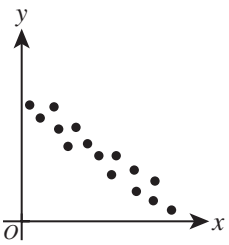
Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

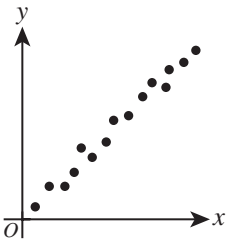
DO YOUR FIGURING HERE.

1. Among the following scatterplots, which scatterplot has the strongest negative linear association between x and y?

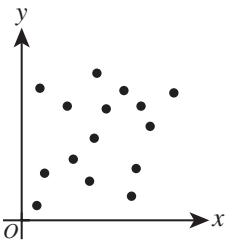
A.



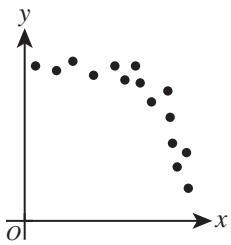
B.



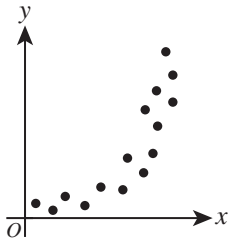
C.



D.



E.



2. Which of the following is closest to the number of **minutes** it would take a ship to travel 90 miles at a constant speed of 20 miles per hour?

A. 13
B. 22
C. 70
D. 270
E. 450

DO YOUR FIGURING HERE.

3. At a local print shop, the total cost, c dollars, to print p programs is modeled by the equation $c = 85 + 1.25p$. According to the equation, how many programs can be printed for $300?

A. 128
B. 155
C. 172
D. 215
E. 240

4. Bella will pick 1 jelly bean at random out of a bag containing 28 jelly beans that are in the colors and quantities shown in the table below. Each of the jelly beans is 1 color only.

Color	Quantity
Green	6
Black	3
Red	5
Orange	2
Yellow	4
Blue	8

What is the probability that Bella will pick a blue or yellow jelly bean?

A. $\frac{1}{3}$
B. $\frac{3}{4}$
C. $\frac{1}{7}$
D. $\frac{2}{7}$
E. $\frac{3}{7}$

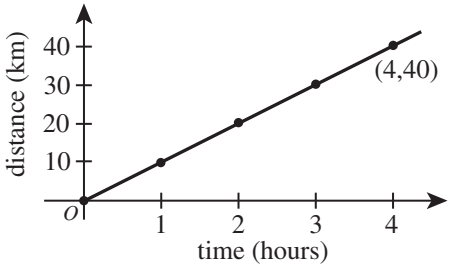
5. The expression $(a^3)^2$ is equivalent to:

A. a^6
B. a^5
C. $2a^3$
D. $9a^2$
E. $6a$

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

6. The graph below gives the plot of distance traveled, in kilometers, versus time, in hours, for a river barge moving with constant velocity.



What is the velocity of the barge, in kilometers per hour?

A. 20

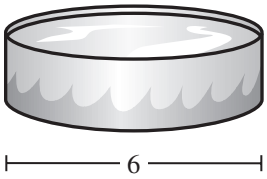
B. 10

C. 4

D. $\frac{1}{4}$

E. $\frac{1}{10}$

7. A children's wading pool, shown below, is in the shape of a right circular cylinder and has a diameter of 6 feet. The pool is filled to a uniform depth of 1.5 feet. Which of the following values is closest to the volume of water in the pool, in cubic feet?



(Note: The volume of a right circular cylinder is $\pi r^2 h$, where r is the radius of the cylinder and h is the height of the cylinder.)

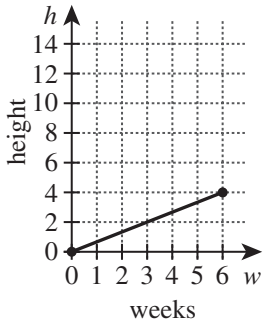
A. 28
B. 42
C. 57
D. 67
E. 133

GO ON TO THE NEXT PAGE.

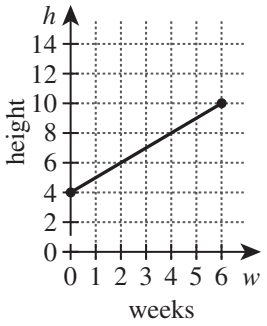
DO YOUR FIGURING HERE.

8. When Jamar purchased a houseplant for his room, it was 4 inches in height. For the next 6 weeks, the houseplant grew taller at a rate of $1\frac{1}{2}$ inches per week. Which of the following graphs best represents the houseplant's height, h inches, versus the number of weeks, w, after Jamar purchased the houseplant?

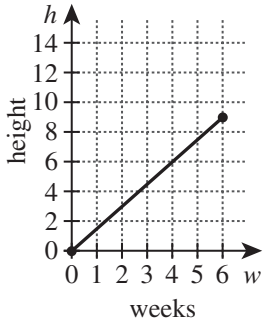
A.



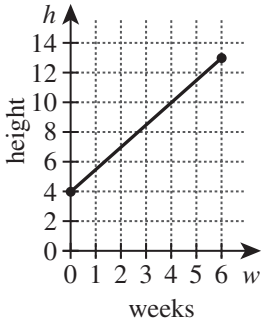
D.



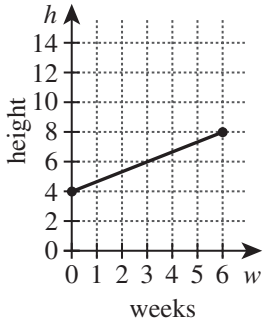
B.



E.



C.



9. Given that $f(x,y) = y^2 - 3x$, $f(10,5) = ?$

A. –20
B. –5
C. 55
D. 85
E. 180

DO YOUR FIGURING HERE.

10. Tomi has 6 pairs of shoes, 4 pairs of pants, and 6 shirts, which can be worn in any combination. He needs to choose a clothes combination to wear to the school dance. How many different combinations consisting of 1 of his 6 pairs of shoes, 1 of his 4 pairs of pants, and 1 of his 6 shirts are possible for Tomi to wear to the dance?

A. 10
B. 16
C. 24
D. 48
E. 144

11. The measures of 2 angles of a triangle are 83° and 64°. What is the measure of the 3rd angle?

A. 19.0°
B. 33.0°
C. 73.5°
D. 97.0°
E. 116.0°

12. Of the following values, which is the least?

A. $|-3|$

B. $(-1)^2$

C. $\left(-\frac{5}{4}\right)^2$

D. $\left(\frac{1}{4}\right)^2$

E. $\sqrt{5}$

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

13. In the standard (x,y) coordinate plane, a triangle has vertices $(-3,-3)$, $(-4,2)$, and $(-1,1)$. What will be the coordinates of the vertices after the triangle is shifted down 2 units?

A. $(-5,-3)$, $(0,-4)$, and $(-1,-1)$
B. $(-5,-3)$, $(-4,4)$, and $(-1,3)$
C. $(-3,-1)$, $(4,-4)$, and $(3,1)$
D. $(-3,-5)$, $(-4,4)$, and $(-1,3)$
E. $(-3,-5)$, $(-4,0)$, and $(-1,-1)$

14. A certain machine produces $3\frac{1}{2}$ kg of a product in $\frac{1}{2}$ hr. What is the unit rate, in kilograms per hour, at which the machine produces this product?

A. $\frac{1}{7}$

B. $\frac{4}{7}$

C. $1\frac{3}{4}$

D. 4

E. 7

15. Which of the following expressions is a factor of the expression $x^2 - 6x + 8$?

A. $x - 3$
B. $x - 4$
C. $x - 5$
D. $x - 6$
E. $x - 8$

DO YOUR FIGURING HERE.

16. The data shown in the table are observed values of the variables x and y of a certain data set. Among all prediction equations of the form $y = kx$ such that k is an integer, there is 1 equation that best fits the data in the table. Based on that equation, which of the following values is closest to the predicted y-value for an x-value of 53.00?

x	y
4.01	24.00
9.80	59.00
19.98	120.00
21.00	126.00
30.00	180.00

A. 73.00
B. 153.00
C. 203.00
D. 318.00
E. 509.00

17. In the standard (x,y) coordinate plane, what is the midpoint of the line segment with endpoints (1,9) and (7,–3)?

A. (–3,–6)
B. (–1,8)
C. (4,3)
D. (5,2)
E. (8,6)

18. In the (a,b) solution to the system of equations below, $b = ?$

$5a = 3$
$2a + 3b = 5$

A. $\frac{3}{5}$

B. $\frac{19}{15}$

C. $\frac{25}{21}$

D. $\frac{25}{18}$

E. 3

19. Which of the following mixed numbers is equal to $2.\overline{3} + 0.\overline{3}$?

A. $2\frac{1}{3}$

B. $2\frac{2}{3}$

C. $2\frac{3}{10}$

D. $20\frac{1}{3}$

E. $20\frac{2}{3}$

DO YOUR FIGURING HERE.

20. If the length, in meters, of the radius of a circle is equal to $a^3 + 7a$ for some value of a, which of the following expressions is equal to the length, in meters, of the diameter?

A. $2a^3 + 14a$

B. $2a^3 + 7a$

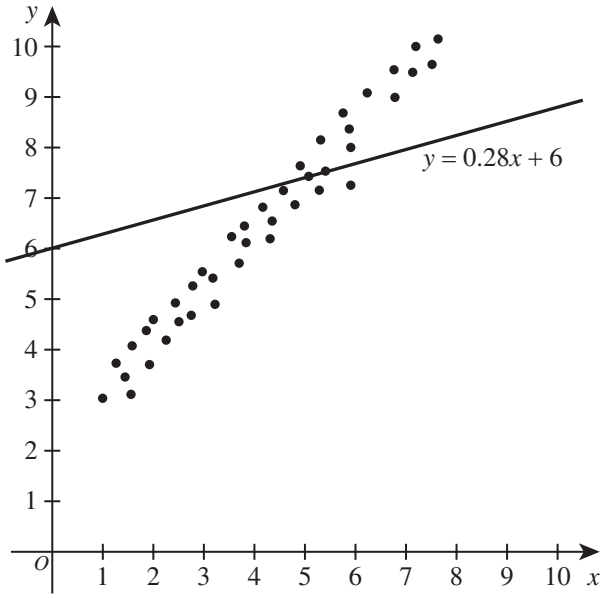
C. $2a^3 + 7a + 14$

D. $a^3 + 14a$

E. $a^3 + 7a + 21$

DO YOUR FIGURING HERE.

21. Jayla plotted the data from her science project as a scatterplot in the standard (x,y) coordinate plane. She found the line containing 2 of the points to be $y = 0.28x + 6$. The scatterplot and the line are shown below.



Jayla decided that this line was not a good fit for her data. To transform her line into the regression line for her data, Jayla **must**:

A. increase both the slope and the y-intercept.
B. increase the slope and decrease the y-intercept.
C. decrease both the slope and the y-intercept.
D. decrease the slope and increase the y-intercept.
E. use either a horizontal or vertical line.

22. The value of a certain car can be modeled by the equation $y = 28{,}000(0.93)^x$ where y represents the value of the car, in dollars, x years after it was manufactured. According to the model, the value of the car will:

A. decrease by 7% per year.
B. decrease by 19.6% per year.
C. decrease by 93% per year.
D. increase by 7% per year.
E. increase by 93% per year.

DO YOUR FIGURING HERE.

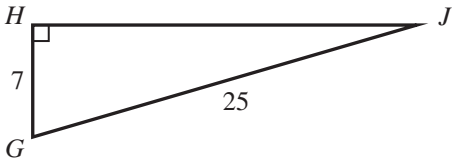
23. Which of the following is a simplified form of $\sqrt{20} - \sqrt{45}$?

A. $-\sqrt{5}$
B. -5
C. 5
D. $5\sqrt{5}$
E. $\sqrt{65}$

24. In the standard (x,y) coordinate plane, what is the slope of the line with equation $3x + 5y = 6$?

A. $-\frac{5}{3}$
B. $-\frac{3}{5}$
C. $\frac{3}{5}$
D. $\frac{5}{3}$
E. 2

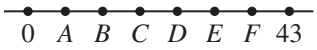
25. The side lengths in the right triangle shown are given in centimeters. What is the length of $\overline{HJ}$ in centimeters?



A. 16
B. 18
C. 24
D. 25
E. 36

DO YOUR FIGURING HERE.

26. The number line from 0 to 43 is divided into 7 segments of equal length by 6 lettered points, as shown. Which of the following phrases describes the location of $\sqrt{43}$ on the number line?



A. Exactly at A
B. Exactly at B
C. Exactly at D
D. Between A and B
E. Between B and C

27. An aquarium will be partially filled with treated water. The portion of the aquarium that will be filled is in the shape of a rectangular prism with dimensions of 30 inches by 84 inches by 48 inches. The cost of filling this aquarium with treated water is \$3.00 per cubic **foot**. To the nearest \$0.01, how much will it cost to fill the portion of this aquarium with treated water?

A. \$40.50
B. \$52.50
C. \$70.00
D. \$210.00
E. \$840.00

28. Which of the following expressions represents the sum of 3.8×10^5 and 6.4×10^4 in scientific notation?

A. 1.02×10^{10}
B. 4.44×10^4
C. 4.44×10^5
D. 10.2×10^{20}
E. 44.4×10^4

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

29. A group of people answered the question, "Which one of these 3 flavors of ice cream is your favorite: vanilla, chocolate, or strawberry?" The table lists the numbers of adults and children that said a certain flavor was their favorite. No person had more than 1 favorite flavor. Which of the following statements is supported by the data in the table?

	Vanilla	Chocolate	Strawberry
Adults	20	24	9
Children	12	32	26

A. More children than adults answered the question.
B. Children like ice cream more than adults do.
C. A total of 100 people answered the question.
D. 20% of people who answered the question said vanilla was their favorite flavor.
E. 9% of adults who answered the question said strawberry was their favorite flavor.

30. In the standard (x,y) coordinate plane, the line $y = \frac{3}{4}x - 2$ passes through which of the following points?

A. (0,0)
B. (1,4)
C. (4,1)
D. (4,2)
E. (4,5)

31. Given the true inequality $\frac{w}{21} > \frac{22 - w}{2}$, which of the following statements about w must be true?

A. w is odd.
B. w is even.
C. w is an integer.
D. w is negative.
E. w is positive.

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

32. Points $O(0,0)$, $P(0,3)$, and $Q(4,0)$ are graphed in the standard (x,y) coordinate plane. A certain dilation of $\triangle OPQ$ that is centered at O will produce the image $\triangle ORS$, where S is located at (8,0). What is the scale factor of the dilation?

A. 2
B. 3
C. 4
D. 5
E. 8

33. In the equation $w = 5n + 6$, w represents the total weight, in ounces, of a carton of eggs and n represents the number of eggs in the carton. All the eggs have the same weight. One of the following quantities is represented by 6 in this equation. Which one?

A. The weight, in ounces, of 1 egg
B. The weight, in ounces, of 6 eggs
C. The number of cartons
D. The weight, in ounces, of the empty carton
E. The total weight, in ounces, of all the eggs and the carton

34. A data set of 9 weights has a range of 12 pounds. Each weight in the data set will be decreased by 3 pounds. The range of the decreased weights will be how many pounds less than the range of the original weights?

A. 0
B. 3
C. 9
D. 15
E. 27

GO ON TO THE NEXT PAGE.

35. The endpoints of a line segment in the standard (x,y) coordinate plane are located at (7,3) and (4,8). What is the length, in coordinate units, of the line segment?

A. 4
B. 8
C. $\sqrt{2}$
D. $\sqrt{34}$
E. $\sqrt{146}$

DO YOUR FIGURING HERE.

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

3

READING TEST

30 Minutes—25 Questions

DIRECTIONS: There are several passages in this test. Each passage is accompanied by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

Passage I

INFORMATIONAL: "An Artist in the Arctic" is an original work of nonfiction.

A two-square-foot print at the National Gallery of Canada in Ottawa, Ontario, features a striking image. On a white background sits an onyx owl with a sharp, cunning gaze. Its eyes are demarcated by an absence of ink, with a hint of feathers suggested by white dots and bold, curved lines. Black talons stretch out below, and long feathers radiate in distinct, solid arcs from the owl's head, back, and tail—first in black and then in vivid crimson. The print is called *The Enchanted Owl*, and while the image is fantastical—far from what one might see in the forest—it is also heavy with an emotional reality. The viewer not only sees the owl but also feels the owl's presence.

The Enchanted Owl was created in 1960 by Inuit artist Kenojuak Ashevak. Born in 1927 in the Arctic region of northern Canada, Ashevak grew up according to a traditional Inuit lifestyle, living in igloos and tents and hunting and fishing with her family. As a child, she was expected to learn a variety of handicrafts, from sewing, repairing, and waterproofing tents to carving stone, wood, and bone for functional and ornamental purposes.

But it wasn't all work. Ashevak was taken with the beauty of her icy surroundings: graceful elk, barking seals, arctic hares, fish, and owls. Colors stood out in contrast with the snowy backdrop; reds were more intense, greens more alive, and even the pale purple predawn had a special glow. Night skies danced with the aurora borealis, a natural light display visible near the polar caps.

In her twenties, Ashevak contracted tuberculosis and was sent to recover at a hospital in Quebec, far away from home. At first, she was discouraged. However, Ashevak learned how to paint as a way to pass time while she healed and was able to find comfort in her art. She showed immediate talent and was encouraged to continue with her art upon her release. She settled with her husband and children at Cape Dorset, a coastal community in the extreme northern reaches of Canada.

There, she met James Houston, who taught printmaking techniques in the area. She and her husband, Johnniebo, frequently convened with other Inuit artists at Houston's collective, working together and sharing supplies. Ashevak honed her craft with paint, colored pencils, and ink, rarely building upon rough drafts of sketches and instead drawing the final version straight from her imagination. Her works were vibrant and dynamic, and Houston recognized a special gift in Ashevak: an ability to take subjects of ordinary life—people, igloos, dogs and sleds, birds and marine life—and turn them from the familiar to the iconic. He asked if the group could take her work and make prints of it, and she agreed. Within a few short years, colorful prints of her work were being sold to, and shown in, galleries across Canada.

Ashevak, who died in 2013, was recognized in her lifetime as an important artist. Her work is displayed in acclaimed museums and galleries throughout the world, where viewers can glimpse the peculiar beauty of the Arctic, as seen through her eyes.

1. The main purpose of the passage is to:

- **A.** describe the characteristics of *The Enchanted Owl* as well as the artistic methods Ashevak used to create the original work.
- **B.** relate how Ashevak's traditional Inuit upbringing and later experiences in northern Canada influenced her artwork, including *The Enchanted Owl*.
- **C.** compare Ashevak's artworks depicting Inuit culture and tradition in northern Canada with her later works, which focused on wildlife.
- **D.** examine the various art mediums Ashevak utilized in creating artwork inspired by her Inuit heritage.

2. Based on the first paragraph (lines 1–13), the author mainly characterizes *The Enchanted Owl* as:

- **A.** eerily unsettling.
- **B.** surprisingly cheerful.
- **C.** oddly puzzling.
- **D.** emotionally intense.

3. In the context of the passage, which of the following words is used in a way that is more figurative than literal?

A. Solid (line 7)
B. Heavy (line 11)
C. Icy (line 24)
D. Pale (line 27)

4. Which of the following statements best summarizes the fifth paragraph (lines 41–56)?

A. Ashevak began working with artists such as Houston who appreciated her unique artistic voice and assisted in distributing her work.
B. Ashevak and her husband developed a camaraderie with Houston, leading them to join his collective to learn printmaking techniques.
C. Fellow Inuit artists at Ashevak's artistic collective in Cape Dorset were the first to develop prints of Ashevak's drawings and paintings.
D. After Ashekvak began attending Houston's printmaking classes, her works were sold to galleries across Canada.

5. Which of the following crafts does the passage indicate Ashevak learned first?

A. Printmaking
B. Painting
C. Stone, wood, and bone carving
D. Drawing with colored pencils

6. According to the passage, during a period in her twenties, Ashevak's art provided her with a sense of:

A. comfort.
B. adventure.
C. nostalgia.
D. relevance.

Passage II

HUMANITIES: This passage is adapted from the essay "Lights in the Windows" by Naomi Shihab Nye (©1995 by The Assembly on Literature for Adolescents).

Years ago a girl handed me a note as I was leaving her proud town of Albany, Texas, a tiny, lovely place far in the west of our big state. "I'm glad to know there is another poemist in the world," the note said. "I always knew we would find one another someday and our lights would cross."

Our lights would cross. That girl had not stood out to me, I realized, among the other upturned, interested faces in the classroom. How many other lights had I missed? I carried her smudged note for thousands of miles.

I was fascinated with the earliest poems I read and heard that gave insight into all the secret territories of the human spirit, our relationships with one another. Somehow those glimpses felt comforting, like looking through the lit windows of other people's homes at dusk, before they closed the curtains. How did other people live their lives? Just a *sense* of so many otherworlds out there, beginning with the next house on my own street, gave me a great energy. How could anyone ever feel lonely? One of the first books I loved in my life was a thick, gray anthology edited by Helen Ferris, called *Favorite Poems Old and New.* Rich, intelligent voices spoke to me each time I opened its covers. I found Rabindranath Tagore, Carl Sandburg, Emily Dickinson, living side by side. I imagined I was part of a much larger family.

To me the world of poetry is a house with thousands of glittering windows. Our words and images, land to land, era to era, shed light on one another. Our words dissolve the shadows we imagine fall between. "One night I dreamt of spring," writes Syrian poet Muhammad al Maghut, "and when I awoke / flowers covered my pillow." Isn't this where empathy begins? Other countries stop seeming quite so "foreign," or inanimate, or strange, when we listen to the intimate voices of their citizens. I can never understand it when teachers claim they are "uncomfortable" with poetry—as if poetry demands they be anything other than responsive, curious human beings. If poetry comes out of the deepest places in the human soul and experience, shouldn't it be as important to learn about one another's poetry, country to country, as one another's weather or gross national products? It seems critical to me. It's another way to study geography!

Anyone who feels poetry is an alien or ominous form should consider the style in which human beings think. "How do *you* think?" I ask my students. "Do you think in complete, elaborate sentences? In fully developed paragraphs with careful footnotes? Or in flashes and bursts of images, snatches of lines leaping one to the next, descriptive fragments, sensory details?" We *think* in poetry. But some people pretend poetry is far away.

Probably some of us were taught so long and hard that poetry was a thing to *analyze* that we lost our ability to find it delicious, to appreciate its taste, sometimes even when we couldn't completely apprehend its *meaning.* I love to offer students a poem now and then that I don't really understand. It presents them with the immediate opportunity of being smarter than I am. Believe me, they always take it. They always find an interesting way to look through its window.

I'm reminded of a dear teacher I had in high school who refused to go on to the next poem in our antiquated textbook until we had all agreed on the same interpretive vision of each poem—*her* vision. If we can offer each other a cognizance of *mystery* through the poems we share, isn't that a greater gift? Won't a sense of inevitable mystery underpinning our intricate lives serve us better than the notion that we will each be given a neat set of blanks to fill in—always?

Poems respect our ability to interpret and translate images and signs. Poems link seemingly disparate parts of experience—this seems particularly critical today. I have yet to meet one person in all my travels who doesn't say they are too busy, they wish they had a little more time. If most of us have lost, as some poets suggest, our meaningful, deep relationships with the world of nature, poems help us to see and feel that world again, beyond our cities and double-locked doors. I have learned as much about nature from the poems of Mary Oliver as I have ever learned walking in the woods.

And since we now live in a world where activities in one person's woods have a direct relationship on countries far away—the disappearing rain forests in southern Mexico and Hawaii and the changing weather everywhere, for example—we need to know one another. It is an imperative, not a luxury.

7. It can most reasonably be inferred that the narrator includes references to several poets to make clear that she:

- **A.** appreciates a wide range of poetry.
- **B.** usually reads poetry that was written by one of the poets mentioned.
- **C.** prefers reading poetry anthologies to reading the full length works by a single poet.
- **D.** prefers Syrian poets to American poets such as Carl Sandburg or Emily Dickinson.

8. It can reasonably be inferred that the narrator's perspective on poetry is most different from that of which of the following people?

A. A girl in Albany, Texas (lines 1–6)
B. Muhammad al Maghut (lines 32–34)
C. The teachers (lines 37–40)
D. The students (lines 59–63)

9. The narrator's statement in lines 18–21 most nearly means that she feels connected to people simply through:

A. knowing the details of their family history.
B. conversing with them occasionally.
C. being aware of their existence.
D. teaching them about poetry.

10. As it is used in line 31, the word *shadows* most nearly means:

A. outlines.
B. reflections.
C. spirits.
D. barriers.

11. The narrator most strongly implies that when she presents her students with a poem she doesn't really understand, she invites her students to:

A. help make the poem's single meaning clear to her.
B. make their own various interpretations.
C. analyze the poem together and as a group decide on its one true meaning.
D. disregard the meaning of the poem and instead study its structure.

12. The narrator states that she was intrigued by the earliest poems she experienced that gave her insight into all the secret territories of:

A. other countries.
B. the human spirit.
C. words and images.
D. the world of nature.

13. The narrator proposes that some people have lost the ability to find poetry inviting as a result of a focus in classrooms on poetry:

A. analysis.
B. writing.
C. recitation.
D. memorization.

Passage III

INFORMATIONAL: Passage A is an original work titled "To Hear the Presence of Everything." Passage B is an original work titled "Dark-sky Parks."

Passage A: "To Hear the Presence of Everything"

Airplanes hum, cars honk, machines buzz—human-made noise pervades our outdoor spaces. Drowned out by the clamor, the world's natural soundscapes are on the verge of extinction. Acoustic ecologist Gordon Hempton hopes to save them. He's working with an organization he cofounded to designate a variety of places around the world, areas that are exceptionally isolated from noise pollution, as officially recognized "quiet parks." The parks will honor and preserve the purest sounds of nature on Earth.

Hempton thinks of Earth as a "solar-powered jukebox," and he wants us to hear more of its magnificent tunes. Nature is always communicating, so the parks will be anything but silent. When human-made noise is absent, rare auditory wonders, the pure sounds that Hempton refers to as "natural quiet," are on full display. The first Wilderness Quiet Park, located on the Zabalo River in Ecuador, was certified in 2019. The space is free of any human-made noise for intervals of at least fifteen minutes, an uncommon occurrence on much of Earth. Over two hundred sites around the globe have been identified as potential "quiet parks."

Quiet outdoor spaces, Hempton believes, benefit all life, sustaining the natural rhythms of wildlife and allowing us a refuge from our noisy existence. In the quiet, we can experience the presence of *everything*: snow melting in the sunshine, wind whistling through tall grasses, frogs croaking near a rippling stream. With this as our soundtrack, we remember how to listen.

Passage B: "Dark-sky Parks"

One form of pollution affects 99% of the US population, yet it's odorless, nontoxic, silent, and appears only at night. It's light pollution. Defined briefly, light pollution is the "overflow" of light from buildings, parking lots, and other human sources. Such light floods into the sky, obscuring stars.

In recent years, organizations and governments have begun to confront light pollution. One effort is the creation of dark-sky parks. To be recognized as a dark-sky park, the location must possess exceptionally low light pollution; all public parks are eligible, as well as private lands that are open to the public. The park must commit to carefully controlling light within the park, as outlined in a lighting management plan.

Visitors to dark-sky parks can literally see the results of the program. Paradoxically, reducing human-generated light makes other things *more* visible. The night skies in dark-sky parks display breathtakingly starry vistas, enabling unparalleled astronomical observation and photography. The Milky Way—the cloud-like belt of stars in our own galaxy—can be seen stretching from horizon to horizon, and sights such as the northern lights and meteorites are bright and dramatic.

Before electric lights, untold generations of humans gazed in amazement at the nighttime firmament. Now, dark-sky parks—about eighty parks and counting—are ensuring that we can have the same nighttime experience our ancestors had, preserving our sense of awe at the vast beauty of our universe.

14. Based on Passage A, which of the following sounds would Hempton consider "natural quiet" (line 16)?

- **A.** The sound of children sleeping in a backyard
- **B.** Wind turbines whirring in the breeze
- **C.** Water dripping off a stalactite in a cave
- **D.** The sound of oars rowing across a pond

15. The author of Passage A includes the two lists (lines 1–2 and lines 25–28) mainly to:

- **A.** contrast sounds heard in everyday outdoor spaces with sounds that can be heard in quiet parks.
- **B.** contrast sounds the author hears most often now with sounds that past generations once heard.
- **C.** point out reduced numbers of wildlife in some areas and the causes of those reduced numbers.
- **D.** point out that loud, everyday sounds cause disruption and distraction, while the most calming sounds have to be listened for.

16. The main function of the second paragraph (lines 36–43) in Passage B is to:

- **A.** detail the step-by-step process by which an organization and government body recognize a location as a dark-sky park.
- **B.** contrast public parks recognized as dark-sky parks with privately owned lands recognized as dark-sky parks.
- **C.** outline the requirements for a location to be considered and remain a dark-sky park.
- **D.** point out the history behind the term "dark-sky parks."

17. Compared to how people today view skies at dark-sky parks, the author of Passage B imagines that our ancestors viewed the night sky:

- **A.** similarly; looking at the skies in dark-sky parks makes people feel small, just like the night made people feel small long ago.
- **B.** similarly; looking at the skies in dark-sky parks fills people with wonder, just as the night sky filled people with wonder long ago.
- **C.** differently; people find the skies at dark-sky parks to be astonishing, but for our ancestors, the night sky was something taken for granted.
- **D.** differently; people find the skies at dark-sky parks to be magnificent, but for our ancestors, the night sky was too much of a mystery to fathom.

18. One main idea of both passages is that:

- **A.** many people have forgotten how to enjoy the natural landscapes that exist near their homes.
- **B.** the less humans intrude on nature, the more humans enjoy nature.
- **C.** maintaining a park takes cooperation among private organizations and government agencies.
- **D.** pollution affects some human senses more than others.

19. The phrase "drowned out" in Passage A (line 3) and the word "floods" in Passage B (line 35) both serve to:

- **A.** point out that nature is still present in urban environments.
- **B.** emphasize the enormous efforts that must be made in order to combat pollution.
- **C.** indicate that many diverse ideas are being researched in order to protect nature.
- **D.** emphasize how widespread pollution has negatively affected nature.

Passage IV

INFORMATIONAL: This passage is from the article "The Dreams of an Inventor in 1420" by Bennett Gilbert.

Sometimes we try to invent something new by exploring within the bounds of what is known to be possible, and sometimes we invent by expanding those limits. For an imaginative engineer in the early fifteenth century — working more than two hundred years before the discoveries of Newton — the process of invention would be often a curious mix of the two. You would know so little about mechanical force that you could conjure up almost anything and believe it to be practical. Of course, attempts to bring the designs to reality would often fail, but they might, on occasion, also succeed.

Suppose for a moment that you were such a person possessing a talent for gadgets in the early fifteenth century, or an engineer hoping to build marvelous machines and clever structures no one else had yet dreamed of — how would you go about showing your talents? And what if you were someone who wanted to own wonderful and mysterious devices, such as a prince — how would you find the person who could make these things? A remarkable testimony to this meeting of engineering skill, technological ignorance, individual initiative, and public demand can be found in the Bavarian State Library, in the sketchbook of an Italian inventor of the early fifteenth century. It is a volume of sixty-eight drawings advertising the inventions that Johannes (or Giovanni) de Fontana (ca. 1395–1455), who was both the engineer and the artist, hoped to sell to patrons. Thought to have been created sometime between 1415 and 1420, the work has no title by Fontana that has survived, but a later owner gave it the title *Bellicorum instrumentorum liber* — the Book of Warfare Devices — despite the fact that most of it does not concern military matters.

Fontana imagined a wide array of projects: mechanical camels for entertaining children, mysterious locks to guard treasure, flame-throwing contraptions to terrorize the defenders of besieged cities, huge fountains, musical instruments, actors' masks, and many other wonders. One of the most remarkable features of his ideas is that many of them are impossible to execute: they simply do not conform to the principles of mechanics. This gives them great charm and makes them more interesting, perhaps, than his more rational or practical proposals. We see similar impractical designs in the very few other engineers' books extant from this early period, most notably in the notebooks of Leonardo da Vinci.

Fontana lived at the time of transition from medieval knowledge of the world to that of the Renaissance, which many now regard as the origin of early modern science. In the same years in which Fontana was working, drawing, and dreaming, other builders and engineers were inventing perspective. Goldsmiths along the Rhine and craftsmen in southwestern Germany and elsewhere were thinking about how to copy letterforms mechanically. Engravers in wood and metal were trying dozens of techniques, some lost to us today, for reproducing images. Engineers and tinkerers were learning how to build grander, lighter buildings and were experimenting with ways to defy gravity.

This article, "The Dreams of an Inventor in 1420," was originally published in *The Public Domain Review* [https://publicdomainreview.org/essay/the-dreams-of-an-inventor-in-1420] under a Creative Commons Attribution-ShareAlike 3.0. If you wish to reuse it please see: https://publicdomainreview.org/legal/

20. The author of the passage would most likely agree with which of the following statements?

- **A.** Though Fontana's designs seem to suggest that Fontana lacked a basic understanding of mechanical principles, they were likely commissioned by another individual, such as a prince.
- **B.** Though Fontana's designs may seem impossible, they were likely never meant to be built; instead, they were intended to be displays of artistic ability.
- **C.** Though many of Fontana's designs were impossible to build, his impractical designs are generally more interesting than his more practical ideas.
- **D.** Though Fontana's designs seem laughable now, his ideas led to the creation of some of the most innovative inventions of the time.

21. The main idea of the first paragraph (lines 1–12) is that:

- **A.** though fifteenth-century engineers were significantly more innovative than the engineers of today, they often failed to bring their designs to reality due to their lack of knowledge of Newton's discoveries.
- **B.** because their inventions were not bound by the laws of mechanics, fifteenth-century engineers often produced more imaginative and innovative inventions than the engineers of today.
- **C.** because fifteenth-century inventors knew so little about mechanical forces, their designs for inventions were often more imaginative than realistic or workable.
- **D.** during the early fifteenth century, inventors knew so little about the laws of mechanics that they were unable to create machines that worked in reality.

22. It can be most reasonably inferred that which of the following individuals mentioned in the passage would have been the least likely to invent something?

- **A.** "An engineer hoping to build marvelous machines and clever structures no one else had yet dreamed of" (lines 15–17)
- **B.** "Someone who wanted to own wonderful and mysterious devices, such as a prince" (lines 18–20)
- **C.** "A person possessing a talent for gadgets in the early fifteenth century" (lines 13–15)
- **D.** "An Italian inventor of the early fifteenth century" (lines 24–25)

23. According to the passage, what did Fontana hope to do with his inventions?

- **A.** Publish them in the Bavarian State Library
- **B.** Showcase them at fairs and exhibitions
- **C.** Offer them for use in military matters
- **D.** Sell them to patrons

24. As it is used in line 34, the word *concern* most nearly means:

- **A.** involve.
- **B.** interest.
- **C.** disturb.
- **D.** worry.

25. According to the passage, compared to the inventions of other engineers at the time, Fontana's inventions were:

- **A.** significantly more practical.
- **B.** slightly more practical.
- **C.** about as practical.
- **D.** significantly less practical.

END OF TEST 3

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO A PREVIOUS TEST.

4

SCIENCE TEST

30 Minutes—30 Questions

DIRECTIONS: There are several passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

Passage I

The spiny water flea *Bythotrephes longimanus* is a nonnative species in Harp Lake, located in Ontario, Canada. Scientists conducted a study to determine the average abundance (the average number of organisms per cubic meter of lake water) of 4 different species (Species K, M, N, and P) of zooplankton (small floating animals and protozoans) in Harp Lake before and after *B. longimanus* were introduced in 1993. Table 1 lists the average abundance for each species at a particular site in the lake each year from 1991 through 1997.

Table 1

	Average abundance (organisms/m^3) in:						
Species	1991	1992	1993	1994	1995	1996	1997
K	1,050	1,150	400	205	100	25	13
M	2,300	3,100	1,600	2,200	2,050	1,000	800
N	69	61	80	15	24	36	41
P	200	250	320	410	1,075	1,000	500

Note: From 1991 through 1997, the lake had an average annual pH of 6.3.

Table adapted from the article "Changes in Zooplankton and the Phenology of the Spiny Water Flea, *Bythotrephes*, Following Its Invasion of Harp Lake, Ontario, Canada" by Norman D. Yan et al. (©2001 by NRC Canada).

1. Based on Table 1, as time elapsed from 1991 through 1997, the average abundance of Species P:

A. decreased only.
B. increased only.
C. decreased and then increased.
D. increased and then decreased.

2. In the study that produced the results shown in Table 1, was year an independent variable or a dependent variable, and was average abundance an independent variable or a dependent variable?

A. Year: independent
Average abundance: independent

B. Year: independent
Average abundance: dependent

C. Year: dependent
Average abundance: independent

D. Year: dependent
Average abundance: dependent

3. Consider the average abundances listed in Table 1 for Species M in 1991, 1993, and 1995. What is the order of these years from the year with the lowest average abundance of Species M to the year with the highest average abundance of Species M?

A. 1993, 1991, 1995
B. 1993, 1995, 1991
C. 1995, 1991, 1993
D. 1995, 1993, 1991

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4. A student claimed that the average abundance of zooplankton in Harp Lake in 1995 was less than the average abundance of zooplankton in Harp Lake in 1997. The data for which of Species K or Species N are consistent with the student's claim?

A. Species K; the average abundance of Species K was 12 organisms/m^3 less in 1995 than in 1997.
B. Species K; the average abundance of Species K was 87 organisms/m^3 less in 1995 than in 1997.
C. Species N; the average abundance of Species N was 5 organisms/m^3 less in 1995 than in 1997.
D. Species N; the average abundance of Species N was 17 organisms/m^3 less in 1995 than in 1997.

5. Was the average annual pH for Harp Lake from 1991 through 1997 acidic or basic?

A. Acidic, because its pH was less than 7.
B. Acidic, because its pH was greater than 7.
C. Basic, because its pH was less than 7.
D. Basic, because its pH was greater than 7.

6. Based on Table 1, the average abundance of Species K the year that *B. longimanus* were introduced was how many times as great as the average abundance of Species K in 1995?

A. $\frac{1}{16}$
B. $\frac{1}{4}$
C. 4
D. 16

7. Consider the claim "The average abundance of zooplankton in Harp Lake was greater in the year immediately before *B. longimanus* were introduced than in the year immediately after *B. longimanus* were introduced." The data for which of the species are NOT consistent with this claim?

A. Species P only
B. Species K and Species M only
C. Species N and Species P only
D. Species K, Species M, and Species N only

Passage II

Demonstration

A teacher attached one end of a string to a small paper cup and the other end of the string to the front end of a toy car of a certain weight in newtons (N). She set the car (Car 1) on a smooth tabletop with the front wheels 0.5 m from the edge and the cup hanging over the edge. She repeated this setup with an identical toy car (Car 2) except a sheet of rough sandpaper was placed under all 4 of the car's wheels. Each of 3 students predicted the number of pennies that would need to be placed in the cup for each car to move.

Student 1

It will take 5 pennies to move Car 1 and 50 pennies to move Car 2. For a car to move, there must be a net horizontal force on the car. Therefore, the weight added to the cup must be greater than the maximum force of friction on the car's wheels. The maximum force of friction applied by the smooth surface is much less than that applied by the sandpaper, so the number of pennies needed to move Car 1 is much less than that needed to move Car 2.

Student 2

It will take 5 pennies to move each of Car 1 and Car 2. Each car has the same weight as 4 pennies; therefore, adding 1 more penny results in a net horizontal force on the cars. The only horizontal force applied on the cars is the weight of the pennies. Neither surface applies a force on the car; therefore, the type of surface does not affect the number of pennies needed to move the car.

Student 3

It will take 25 pennies to move Car 1 and 50 pennies to move Car 2. The maximum force of friction applied by the smooth surface is larger than described by Student 1; therefore, the horizontal force applied by the weight of the pennies must be larger for the car to move. Student 1 is correct that the maximum force of friction applied by the sandpaper is larger than that applied by the smooth surface, so the number of pennies needed to move Car 2 is greater than that needed to move Car 1.

8. Which of the following variables was(were) the same for both cars in the demonstration?

I. The weight of the car
II. The initial surface under the car's wheels
III. The initial distance between the car and the edge of the table

A. I only
B. II only
C. I and III only
D. I, II, and III

9. Which of the students stated that only 1 horizontal force is applied on Car 1?

A. Student 2 only
B. Student 3 only
C. Students 1 and 2 only
D. Students 1 and 3 only

10. The weight of a single penny is 0.025 N. Student 3 would most likely predict that the maximum horizontal force of friction applied on the wheels by the sandpaper is closest to which of the following?

A. 0.025 N
B. 0.625 N
C. 1.250 N
D. 1.875 N

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11. Assume that both cars were set up on the same table and the teacher added pennies, 1 to each of the cups at the exact same time, until a car began to move. Would Student 1 be more likely to predict that Car 1 or Car 2 would begin to move first?

A. Car 1, because according to Student 1, fewer pennies need to be added to the cup for Car 1 than for Car 2 to get the cars to move.
B. Car 1, because according to Student 1, more pennies need to be added to the cup for Car 1 than for Car 2 to get the cars to move.
C. Car 2, because according to Student 1, fewer pennies need to be added to the cup for Car 1 than for Car 2 to get the cars to move.
D. Car 2, because according to Student 1, more pennies need to be added to the cup for Car 1 than for Car 2 to get the cars to move.

12. Which of the following statements regarding the length of the string used is consistent with the description of the demonstration? The length of the string, in centimeters, was:

A. less than 1 cm.
B. between 1 cm and 10 cm.
C. between 10 cm and 50 cm.
D. greater than 50 cm.

13. Student 1 and Student 3 disagree on which of the following points?

A. The weight of the car
B. Which car will require more pennies to move it
C. The maximum force of friction applied by the sandpaper on the car's wheels
D. The maximum force of friction applied by the smooth surface on the car's wheels

14. Suppose the demonstration were repeated with a third identical car except a sheet of waxed paper had been placed under the car's wheels. How many pennies would Student 2 have been likely to predict would be needed to move the third car?

A. 4
B. 5
C. 10
D. 50

15. Which of the following statements regarding the net horizontal force when Car 1 and Car 2 are at rest is consistent with the prediction of Student 1? When at rest, the net horizontal force applied on Car 1 is:

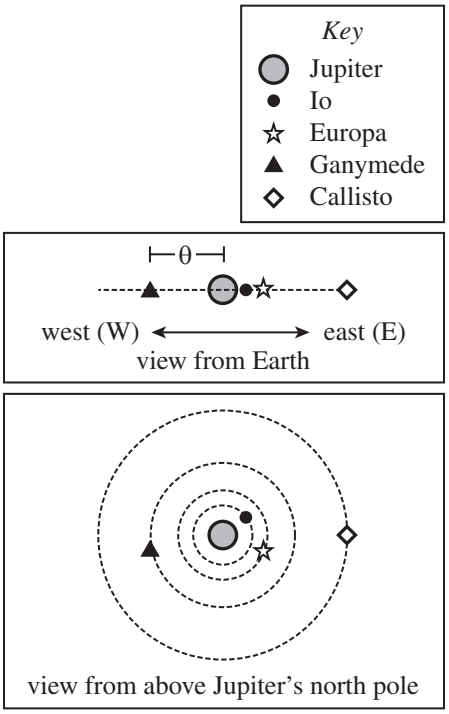
A. less than the net horizontal force applied on Car 2.
B. greater than the net horizontal force applied on Car 2.
C. the same as the net horizontal force applied on Car 2 and equal to 0 N.
D. the same as the net horizontal force applied on Car 2 and equal to 5 N.

4

Passage III

As viewed from Earth, Jupiter's 4 largest moons—the Galilean moons—appear to move relative to Jupiter along an east-west line. The farther from Jupiter a moon appears to be, the greater its angular separation, θ. Figure 1 shows these moons' positions at midnight on a certain day in June 2012 as viewed from Earth (top section) and as viewed from above Jupiter's north pole (bottom section).

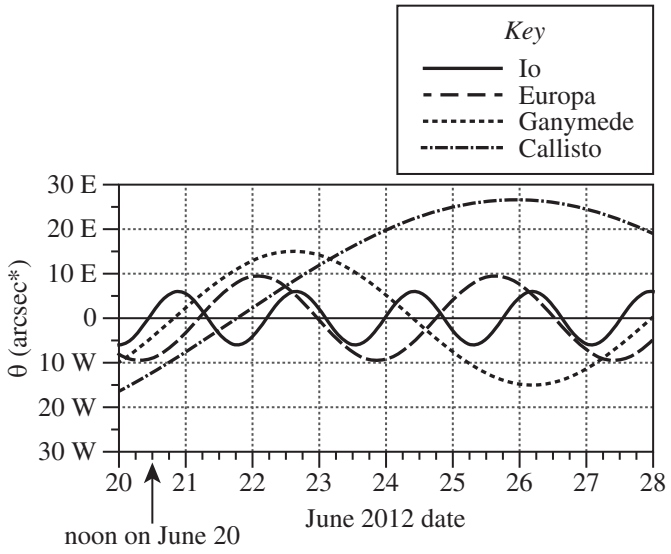
Figure 1



Note: The figure is not drawn to scale. In the top section, only θ for Ganymede is shown.

Figure 2 shows θ for each moon from midnight on June 20, 2012, to midnight on June 28, 2012. For each moon, 1 wave cycle represents 1 orbit around Jupiter. (The time to complete 1 orbit is the time between any 2 consecutive peaks or any 2 consecutive troughs.)

Figure 2



*arcseconds

Figure 2 adapted from Sylvain Rondi, *Jupiter Version 2: Programme gratuit de calcul d'éphémérides des satellites galiléens de Jupiter*. ©2009 by Sylvain Rondi.

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16. The number of orbits per week is a measure of orbital frequency. Based on Figure 2, which Galilean moon has the highest orbital frequency?

A. Io
B. Europa
C. Ganymede
D. Callisto

17. Based on Figure 2, Callisto completes 1 orbit around Jupiter in approximately how many days?

A. Fewer than 4 days
B. Between 4 and 6 days
C. Between 6 and 8 days
D. More than 8 days

18. Based on Figure 2, as viewed from Earth at midnight on June 27, which Galilean moon appeared farthest west of Jupiter?

A. Io
B. Europa
C. Ganymede
D. Callisto

19. Based on Figure 2, at noon on June 23, θ for Ganymede was approximately:

A. 10 arcsec east.
B. 10 arcsec west.
C. 14 arcsec east.
D. 14 arcsec west.

20. Based on Figure 2, at which of the following times in 2012 was the angular separation for Callisto closest to 20 arcsec east?

A. 6:00 a.m. on June 26
B. 6:00 a.m. on June 27
C. 6:00 p.m. on June 26
D. 6:00 p.m. on June 27

21. Thebe is one of Jupiter's smaller moons. Thebe completes 1 orbit of Jupiter in approximately 0.7 days. Based on Figure 2, regardless of direction, the maximum value of θ for Thebe is most likely:

A. less than 7 arcsec.
B. between 7 arcsec and 10 arcsec.
C. between 10 arcsec and 13 arcsec.
D. greater than 13 arcsec.

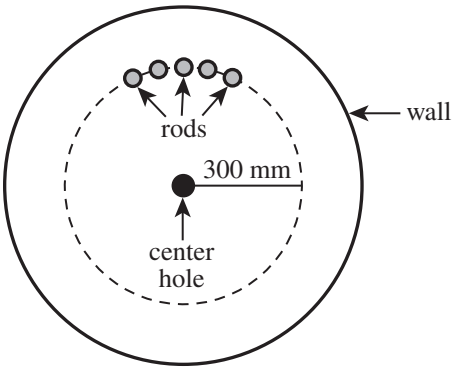
4

Passage IV

A study examined differences in the ability of nymph (juvenile) and adult praying mantis insects to locate an area that had visual contrast from the environment.

A cylindrical chamber with a diameter of 1,000 millimeters (mm) and a height of 600 mm was constructed. The interior wall was white, and a circle of radius 300 mm was drawn around a hole in the center of the chamber. A set of 5 rods painted a certain color that had contrast with the interior wall was placed on this circle (see Figure 1). A box was then attached beneath the center hole, allowing a mantis in the box to enter the chamber. For each contrast level tested, light intensity and chamber temperature were constant.

Figure 1



Study

A set of black high-contrast rods was placed in the chamber. A total of 50 nymph, 25 adult female, and 25 adult male mantises were obtained, and a single mantis was placed into the box. After the mantis entered the chamber, the pause distance (PD, the distance from the rods at which the mantis first paused movement to look at the rods) was recorded. The mantis was then immediately removed from the chamber, and another mantis was placed into the box. This was repeated until each mantis was tested.

Using the same mantises, the procedures were repeated for a set of dark-gray medium-contrast rods and then a set of light-gray low-contrast rods. Table 1 lists the average PD for each mantis type at each contrast level tested.

Table 1

Contrast level	Average PD (mm) for the:		
	nymphs	adult females	adult males
High	270	280	280
Medium	190	280	280
Low	170	250	270

Figure and table adapted from the article "Orientation Behavior With and Without Visual Cues in Newly Hatched and Adult Praying Mantis" by Karl Kral. (©2013 by Springer Science+Business Media New York).

22. Consider the contrast level that resulted in an average PD of 270 mm for the nymphs. The set of rods for this contrast level was painted what color?

A. White
B. Black
C. Dark gray
D. Light gray

23. Based on the results of the study, for the medium contrast level, the average PD for the adult males was how much greater than the average PD for the nymphs?

A. 10 mm
B. 80 mm
C. 90 mm
D. 100 mm

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24. Based on the description of the chamber, what was the approximate distance between the rods and the chamber wall?

A. 200 mm
B. 300 mm
C. 500 mm
D. 700 mm

25. Based on the description of the study, was the total number of nymphs tested less than, greater than, or equal to the total number of adult mantises tested?

A. Less; a total of 25 nymphs and a total of 50 adult mantises were tested.
B. Greater; a total of 50 nymphs and a total of 25 adult mantises were tested.
C. Equal; a total of 25 nymphs and a total of 25 adult mantises were tested.
D. Equal; a total of 50 nymphs and a total of 50 adult mantises were tested.

26. The study was most likely designed to test a part of which praying mantis body system?

A. Skeletal
B. Nervous
C. Digestive
D. Circulatory

27. Consider the color of the interior wall used in the study. If the color of the interior wall did not change, to determine whether a mantis reacted to the presence of rods instead of contrast level, which combination of rod color and wall color should also have been included in the study?

A. Black rods and black interior wall
B. White rods and black interior wall
C. Black rods and white interior wall
D. White rods and white interior wall

28. Based on the description of the study, a mantis was removed from the chamber immediately after the mantis completed which of the following actions?

A. Pausing of movement
B. Moving toward the rods
C. Moving away from the rods
D. Emerging from the center hole

29. Which of the following statements comparing average PD values is NOT consistent with the results of the study?

A. For the adult females, the average PD at high contrast was greater than the average PD at low contrast.
B. For the adult males, the average PD at high contrast was greater than the average PD at low contrast.
C. At low contrast, the average PD for the adult females was greater than the average PD for the adult males.
D. At low contrast, the average PD for the adult females was greater than the average PD for the nymphs.

30. Some mantises move by jumping. Based on the description of the chamber, what assumption about the maximum height a mantis can jump was likely made when designing the chamber? The maximum height a mantis can jump is:

A. less than 600 mm, so the chamber wall was constructed to a height of 600 mm.
B. less than 600 mm, so the chamber wall was constructed to a height of 1,000 mm.
C. greater than 600 mm, so the chamber wall was constructed to a height of 600 mm.
D. greater than 600 mm, so the chamber wall was constructed to a height of 1,000 mm.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

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